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THE EVOLUTION OF HORTICULTURAL SYSTEMS IN NATIVE SOUTH AMERICA CAUSES AND CONSEQUENCES

A SYMPOSIUM

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[title page]

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YARURO INCIPIENT TROPICAL FOREST HORTICULTURE

Possibilities and Limits

Anthony LEEDS

The immediate concern of the papers in this symposium is the interaction between human populations and their habitats through the agency of horticulture insofar as factors in this interaction result in the evolution of culture. The present paper discusses an Incipient Tropical Forest Slash-and-Burn Horticultural group, the Yaruro of the south-central Venezuelan llanos, in order to show what kinds of upper limits were set upon its development by its technology and habitat, or both, and what sorts of factors within the relatively limiting conditions of incipient tropical forest horticulture might have provided a foundation for evolution to a more developed state. For any of the cultures which are examples of this class of horticulturalists, slash-and-burn horticulture plays a considerable, but usually not, by itself, a dominating role in the total food procurement process. The Yaruro fall between the Incipient and Intermediate Tropical Forest types discussed in the introduction, whereas the Siriono, for example, represent a culture near the lower limits of cultures of the type. Despite their somewhat more advanced condition, what pertains to the Yaruro, in a general way applies to the rest of the type.

We shall consider first the habitat conditions in which the Yaruro find themselves and then describe the major dimensions of their swidden horticultural technology. With these aspects of the total ecology before us we shall show how its characteristics provide us a model for our incipient tropical forest stage and at the same time demonstrate how its special ecological conditions inhibited its further evolution into the more advanced stages of horticulture.

The Venezuelan llanos stretch as a low inland plain from the Orinoco delta, W by WSW, 750-800 miles inland, to the edges of the Andes in the far west of Apure State and into Eastern Colombia. The Yaruro are found between 450 and 600 miles from the mouth of the Orinoco, but still inside Venezuelan frontiers. They are found on all the rivers from the Arauca to the Cinaruco, inclusive, a distance of about 90 miles from north to south.

[probably should read: which--Analyst]

133 As one goes inland from the coast and westward through Yaruro territory, the land slowly rises so that the town of San Fernando de Apure is about 100 feet above sea level; Palmarito de Guachara, about 60 miles southwest, is just 145 feet; and the Cinaruco river about 100 miles SSW is about 190-200 feet. From the middle Cinaruco, the site of the writer's field work, to the sea, the average slope is 0.007% or 4 ½ inches/mile, but the slope increases gradually as one goes west till nearly 200 miles to the west, the plains abut on the Andes where, within a space of about 50 miles, the land rises from about 650 feet to over 12,000.

132 The slope of the land is paralleled by a gradual increase in total annual rainfall and length of rainy season, respectively averaging for the region as a whole about 1600 mm (63") annually,[1] and about 5 months of heavy rains with 2-3 transitional months of unsettled weather with considerable
134 rain. The slope and climatic gradations are paralleled, furthermore, by an orderly series of soil and vegetation types. As one moves steadily nearer the mountains, the soils change from muds, as at San Fernando, to muddy and sandy loams at Guachara, to sands and sandy loams in the central Cinaruco, and increasingly to sands and pebbly areas. These micro-ecological
[184] differences appear to determine micro-cultural differences among various groups of Yaruro as one goes westwards, for example in the specific content of the cosmology. Space only permits us, here, to deal with the Cinaruco area.

133 The dip of the strata, hence drainage, is from West to East. The slope of the dip is so small, as we have noted, that at the first sizable rains, the flow exceeds the carrying capacity of the stream beds and flood-
[132] ing occurs. Thus, during the rainy season from May through September, during which from 85-90% of the annual rain occurs, there is a constant tendency to flood, while during the driest months from December through March, not more than a total of 3 inches falls, and the rivers and landscape dry up often totally, presenting desert-like conditions. Because the topography of the central Cinaruco area is not level in large areas, and even in the flat parts, is raised above the level of the streams, flooding occurs more because of accumulated rain in low spots where it cannot drain than from overflow from streams. The streams themselves are swollen and in places overflow their banks for short distances before they are enclosed by the higher terrain. The west-east dip of the land an the east-west prevailing winds combine to make surface land forms, such as sand dunes and creeks, called *caños* (Y. *doro*) run east and west also.

133 In the central Cinaruco area, the creeks on the north side of the river
137 are contained in a sort of basin formed by a row of dunes, perhaps as high as 100 feet above the neighboring savanas, almost 300 feet above sea level, running east and west for many miles at a distance of 3-5 miles from the Cinaruco. On the south side of such "ranges" of dunes, a creek like the Totúdoro is likely to be found. On its right bank, sometimes at some
[134] distance back from the normal high water mark, it is contained by the edge of the flat, sandy, coarse-grassed savana, which is marked by a continuous

[1] [for footnote see category 116, p.42 --Analyst]

narrow band of soft, red-brown, heavy pebbles, sometimes agglomerated into chunks as large as a man's head. These, the only stones of this area, are entirely absent to the north-east and are technologically useless. Between these bands, which appear to represent flood levels or banks of older streams into which the present beds have been incised, and the streams themselves, low-lying areas are found which are soggy to a depth of a couple of inches above a clayey-sandy hardpan, and are covered with a sleezy layer of organic remains. Grasses appear slightly less barren here than in the areas beyond the pebble banks, the savanas proper. 133 134 [137]

The savanas run east-west for miles and may be one or more miles wide, broken here and there by either strips of dunes or patches of woods, called *montes* (Y. *hŏi*), growing in somewhat saucered hollows which may once have been parts of stream beds. On the upper level savanas (*Y.ciri*), the soil is largely sandy, with occasional scatterings of pebbles at the juncture with the lower savana level 12 to 15 feet below it. Grasses are course, tough, long-rooted, and sparse, giving a barren, yellow appearance even in mid-rainy season. Only a few scrubby trees are seen on the open moors, mostly in wetter spots. These sandy savanas have long since been leached of practically all mineral content, as soil tests show.[2] The savanas constantly tend to lose their finer particles of soils, which are deposited near the streams where the latter have cut down a few feet into the surface of the savana. Thick and rich soil layers are thus created. It is in such layers that soils mechanically more suitable for horticulture combine with a water supply which suffices not only in the wet season, but also provides a dry-season water table accessible to long-rooted flora. This combination fosters the growth of gallery forests, here, which constantly add humus to the very limited areas of better soils provided in this habitat. The width of these layers depends on the depth of the stream's incision and the amount of flow as well as on the presence and relative distance of the dunes and the high and low savanas from the streams, and on the slope and width of the low savana next to the stream. Maximum width of these layers occurs where the streams are more incised and the slope from the higher savana to the streams is a steady descent, so that drainage occurs without flooding and waterlogging, while the dry-season water-table is not too far below. Under any other conditions, these places are narrow, or may almost disappear. Thus, the mouths of *caños* have narrow or no strips of gallery forest since the level of the savana is little above that of the stream, and little soil accumulates at the same time that flooding is heavy. On the upper reaches of streams, *caños* are little incised, the slope from the high savana is insufficient to have deposited much soil, and the forest again disappears. Thus only the median stretches of streams are well-forested and it is only in these areas that horticultural soils are available. Only the *montes*, those depressions in the savana surfaces, which, though above permanent water, nevertheless are nearer the water table than the surrounding savana, provide other suitable, if dry, areas for planting. Here too are found tall tropical hardwood forests which somewhat enrich their own soils by a very thin layer of humus. 137 134 [133]

[2] [for footnote see category 116, p. 42 -- Analyst]

241 With respect to these habitat conditions, the single most important, and, in the case of the Yaruro, predominant subsistence activity is swidden-ing, also called brand tillage, slash and burn horticulture, milpa, or shifting horticulture,[1] a type of subsistence which peoples in both tropical and temperate forested areas of the world have practiced and still practice widely. The procedure followed by the Yaruro is very much like that of other swiddeners.[2] A garden site is chosen in virgin forest or preferably in second growth. During the dry season, the underbrush is first cut out and then the larger trees are felled by a variety of techniques including the use of machetes, axes, or girdling. The cut trees and brush are left to dry during the remainder of the dry season. Just as the first rains are approaching, these logs, along with whatever smaller underbrush may be standing, are set afire. The smaller materials largely burn up while the charred remnants of large trees lie scattered about. Burning partially destroys the [134] humus, as does removal of the forest cover, and to a degree disturbs the soil structure,[3] consequently often speeding the decline of soil fertility despite the addition of organic material from the rotting of partially burned tree boles. Also ash from the burned wood contributes some fertilizing minerals to the soil, thus increasing the short-term fertility of the soil before it is exhausted by man, plants and rain.

134 The destruction of the forest cover and of the humus layers exposes
241 the plots to more drastic leaching or erosion by tropical rains. This fact, together with a decrease in fertility from continual replanting and harvesting in unweeded and uncultivated soils, accompanied by a gradual but drastic invasion by weeds and grasses, makes further use of the plot uneconomical at best and impossible at worst. It is abandoned in favor of some entirely new plot or one which has been reconstituted by long fallowing. Abandoned plots overgrown by weeds and grasses, though they may soon recover their fertility, are so difficult to work with the characteristic swidden horticultural tools,[4] the digging stick and the machete, that they generally cannot be recultivated until a new forest cover has grown up and shaded out smaller vegetation. This usually takes a number of years, in general a minimum of 10 to 15 years, though, in other parts of the world this range may be extended in both directions.[5]

241 Planting is carried out beginning just before or just at the inception of the rains and just after the burning. It may be continued at intervals during the rainy season in order to stagger the harvests. Plantings may be staggered through part or all of the dry season, if climate and horticultural conditions permit, to create a more or less continuous crop, and the probability of a correspondingly higher annual productivity per capita and per land area. Where marked differences between seasons are not found, the entire process may be more or less continuous throughout the year. Irrigation, terracing, and fertilization (other than natural fertilization resulting from silting) are not used.

311 The remaining land surface presents resource areas of various types. In passing, it should be noted, though it is too often thought to be self-evident and consequently not specified, that what constitutes a resource

1,3,4,5,6 [for footnote see category 116, p. 42--Analyst]

area is only such in reference to the presence of a given technology. The presence of such a technology is not guaranteed in any particular culture by any historical, evolutionary, geographical, or ecological necessity. Its presence may entail a particular historical explanation or a general evolutionary one. In any case, its absence entails the absence of the use of certain resources whose presence we can observe only in retrospect. 311

Other resource areas besides those utilized because of the presence of horticulture among the Yaruro become available by their possession of hunting, gathering, and fishing technologies, as well as recently acquired animal husbandry in the form of pig-herding. Hunter animals include deer, armadillo, capybara, paca, peccary (?), iguana, and a number of birds (see Table II, p. 4)[1]. These are variously distributed spatially according to the specific ecological niches for which they are adapted. Thus deer are apparently usually found dispersed in the somewhat damper, low-lying savanas where grass is greener and water more available away from the scene of human activity. Armadillo are found distributed throughout the savana. Other species, however, such as the capybara, live near the edge of permanent waters, mainly the rivers. Alligators also live only in the rivers. The faunal carrying capacity of the savanas appears to be quite low in the Cinaruco llanos since foraging foods for larger game animals are sparse. It is important to note that not only is the overall carrying capacity governed by the minimum average food supply of the savanas in the florally more restricted dry season,[1] but the distribution of animals varies considerably from the wet to the dry season. In the latter, animals tend to cluster nearer the rivers or the widely dispersed water holes. Consequently, the locus of hunting must also shift seasonally (see Maps)[2]. Savana hunting techniques are neccessarily different from those used in procuring food in the rivers, whether hunting alligators or capybara, or, of course, fishing. There is some seasonal variation in the locus of fishing, too, although this is much less marked on the Cinaruco than on the freely-flooding streams of the flatter, more north-easterly savanas of the Apure llanos. In the rainy season, fish move up the larger streams into somewhat shallower waters where more plant and insect food is available to them. However, they are apparently unable to move up smaller streams which often have rapids-like stretches interrupting their course. Thus fishing in the rainy seasons is directed towards the larger creeks and away from the smaller creeks and the river itself, where the water has become too deep for successful fishing since the fish are scarcer and more difficult to see in the deep, swift currents of winter. In respect to animal husbandry, recently introduced pigs are pastured anywhere in the savanas but preferably next to the village or quite a distance from it, in either case far from the nearest gardens (Sp. *conuco*, Y. *tadó*), an effort which is rarely successful, since the pigs, in their wisdom, are among the main predators on the garden crops. Gathering may be carried out in the dry or the wet savana depending upon the plant food to be gathered, or it may be carried out near the creeks especially for the fruit of the moriche palm. The rivers do not appear to be used in gathering. 224 137 [221] 226 133 231 [241] 222

[1] [See pp. 35-37, category 116 --Analyst]
[2] [see pp. 40-41, category 102 --Analyst]
[1] [for footnote, see p. 42, category 116 --Analyst]

311 In short, the habitat conditions are as follows, given that the Cinaruco
22 Yaruro have a technology including hunting, gathering, fishing, and animal husbandry, and horticulture. All resources are found within a narrow band of about 4-5 miles between the Cinaruco river and the high sand dunes occurring in the interfluve to the north, in which only an occasional deer is found. Within this space there are three major resource areas distinguishable: 1) the open savanas for hunting and gathering, the former involving much greater dispersion of resources than the latter and consequently quite different techno-social conditions. Both activities change location markedly with the seasons. 2) The rivers and *caños* are used for water-animal hunting and for fishing. Fishing also displays a seasonal shift between river and caño, whereas river hunting for alligator and turtle becomes totally impracticable in the wet season. 3) The wooded areas, themselves dispersed, include the gallery forests of smaller streams where flooding is limited but water
[241] and soil abundant and the *montes* occurring here and there in mid-savana. These areas provide the Yaruro with garden sites. Away from the streams, there are also occasional tiny patches of suitable soil not close enough to the water table for dry season use, but which get enough rain to be used for planting of seasonal crops in the wet season. Schematically, the situation is shown on Table II[A1], a list of foods entering into Yaruro economy and their relative seasonal occurrences, and on Maps I and II[A2] of the seasonal locations of these resources.

182 The particular relationship between a peculiar habitat, such as the one we have just described, and the technology operating within it, here preponderantly a swidden technology, sets upper limits to territorial, socio-economic, or cultural expansion, and limits to changes in socio-cultural forms. With regard to the habitat dimension of the relationship, we may
[121] say in Harris's words, "Limitations imposed by the manner in which plants and animals convert solar energy into comestible material in combination with the availability of land and water resources, the rate of reproduction of the natural biota, and the total ecological balance, furnish conditions unalterable by individual or collective whim",[A3] at least with the given level of technological development possessed by the Yaruro. The Yaruro are in no position to change the total ecological balance, to increase the carrying capacity of the land or water for plant or animal species. For
182 example, under the llanos conditions, the use of slash-and-burn horticulture
241 exhausts arable land at a rate greater than it recovers. The proportion of
311 land held in reserve for future cultivation must be several times greater than that under cultivation at any given moment, the proportion varying with such factors as the rate of fertility recovery, the type of weed and grass invasion, the rate of growth of the secondary forest, the rate of mechanical reconstruction of the soil, and so on. Thus of the total amount of land potentially available in a given expanse of territory, only a part can be horticulturally exploited at any one time. Where the total potentially arable land in a given expanse is itself only a small proportion of the total area, the amount of land available for cultivation at any one moment is, of course, minute. This ecological balance in turn limits the human population

A1 [See pp. 31-39, Category 116 -- Analyst]
A2 [See pp. 40-41, Category 102 -- Analyst]
A3 [for footnote, see p. 42, Category 116 -- Analyst]

and socio-economic forms. Nor can any immediate desire or fancy of the Yaruro change the limitations which the ecological relationship imposes: the carrying capacity of the land for horticultural food plants has, with the given technology, a fairly fixed upper limit. That such limitations exist for their horticulture is recognized by the Yaruro themselves to some extent. First, they recognize that, given the types of soils extant in the habitat, only certain kinds of crops can be used in certain places. Their knowledge in this regard seems to be quite accurate, and, of course, determines where a garden will be prepared at any given time according to projected needs, existing resources, and past exploitations. Again, they know that a swidden lasts three years, a fact not only confirmed by the evidence of conditions in recently abandoned patches but also by the results of soil analyses.[9] After the three years, they say, the swidden must be allowed to fallow for a number of years. They use the word 'five', but the writer believes 'five' is intended to mean 'some' years. The conditions of abandoned gardens, with their rank growth of lush grasses, unmanageable with dibble or machete, and of the places chosen for preparing new gardens, all cut out of relatively large second growth, suggest that the fallow period is at least 10 years, and probably upwards. We shall use 10 years as a basis for calculations below, since after such a time, the shade has driven out the succulent grasses which are replaced by herbaceous plants or woody underbrush. In view of these considerations, it may be said that Yaruro horticultural practices have been well-adapted to the particular soil and water conditions of their habitat on the basis of explicit recognition of these conditions.

Without basic change in their technology, the balance between the Yaruro's present technology and the habitat conditions we have described set real upper limits both on production and on productivity, the latter defined as production per capita per year, and therefore sets limits on the absolute size and the form of the society. Let us suppose optimal population conditions unlike the present continuing depopulation due to western diseases and massacres by Venezuelans were present as an hypothetical ideal state. The tendency of any plant or animal population is to increase until it balances in a stable equilibrium with the available nutritional resources, other factors constant.[10] If the population increases beyond this point, either a portion of the population must seek elsewhere for its food, or a portion must die, or the population will exploit the resources so as temporarily or permanently to reduce them to lower potentials, as in the case of cattle overgrazing pastures. A new land-population equilibrium is then reached at a somewhat lower level. The only other possibility is to innovate new forms of exploitation, a point we return to below.

Under optimal conditions, then, we may estimate maximum Yaruro population within the boundaries of such a territory as presently occupied by the Caño Totúdoro Yaruro of the Central Cinaruco, a territory bounded for all practical purposes by walking-and-working distance from the village. Within this area of about 65 sq. mi. a maximum of about 800 acres, or that 2% of the total area which is wooded, contains all tillable land. However,

9,10 [for footnotes see p. 42-48, category 116 -- Analyst]

311 within these 800 acres, much is occupied by the streams, calculated at their
241 flood maxima which define non-gardenable areas, while other parts are inadequate in soils or water for use as gardens. Consequently, the actually tillable areas comprise a maximum of about 200 acres or about 0.5% of the land surface. It should be noted, of course, that all these 200 acres are not usable for crops since those in the *montes* cannot be used for cane and bananas, while the wet areas nearest the streams cannot be used for corn or manioc. Thus the maximum area for the staple crops, manioc, corn, and bananas, is about 145 acres (see Table I).[1,11]

168 Using Carneiro's equations,[13] we may estimate the maximum population
311 which would be in equilibrium with this acreage, estimating .5 acres as an approximate amount of land required to provide the average person with the food he ordinarily derives from cultivated plants per year.[13] The calculation gives us 92 persons (see Figure 1).[14] We may also estimate the number of years (L) the group may stay in the present locality with its present population of 24 before wearing out the available tillable land so that they would have to move (see Figure 2). This would be 50 years. Since the entire fallow and planting cycle of any piece of land is only 13 years, under present circumstances, the Totúdoro Yaruro will not have to move from their present territory at all, in view of their small and decreasing population.

[128]

Figure 1

$$P = \frac{\frac{T}{(R+Y)} \times Y}{A}$$

$$P = \frac{\frac{200}{10+3} \times 3}{.5}$$

$P = 92$ (=67 if R is 15)

Figure 2

$$L = \frac{T}{\frac{P \times A}{Y}}$$

$$L = \frac{200}{\frac{24 \times .5}{3}}$$

$L = 50$ years

R = year of fallow
Y = years of productivity
A = land used to provide plant food for one person a year
P = population
L = number of years group located in one place
T = acres of cultivable land within walking-working distance of village

[262] The ideal figures given above would be somewhat modified upwards by the additional foods provided by fishing, hunting, and gathering which, in the wet season, constitute about 30% of the diet and, in the dry, perhaps

[1] [for Table I see pp. 28-30, category 116--Analyst]
[11,12,13,14] [for footnotes, see p. 43, category 116--Analyst]

50% of the diet or a little less. The ideal figures would again be reduced, on the other hand, by allowing for the predations on gardens of animals, especially the pigs, which eat manioc and corn, the Guahibo Indians who allegedly steal sugar cane, and insect losses. Our figures, then, will be modified only a few units by the additional sources of foods. We may thus revise our population figure to between 100 and 105 (or, if a 15-year fallow period is assumed, the figure would be 75-80), figures which correspond to the Yaruro's own ideal of what a proper population for this area should be. If the population increased beyond this number of people, the Yaruro would have to exploit their gardens at a rate greater than the rate of land reconstitution, and also expand hunting, fishing, and gathering beyond the average long-term carrying capacity of the savanas and the rivers, thus reducing their potential productivity. Adding together the maximum populations supportable by these food resources, as well as by the recently introduced pigs, a figure approximating 125-150 persons might be reasonable for this particular territory. This gives a density of 2 persons per sq. mile, a characteristic figure for tropical forest tribes.[15A]

If the population rose beyond this maximum capacity of the land-technology relationship, groups would either have to fission off, go on the warpath, regulate population by any of a number of internal institutions such as infanticide, or die either from extreme famines or from steady nutritional deficiency. Under present population conditions none of these is necessary, yet both fissioning and population regulation by contraception occur. Fissioning appears to be fostered by the search for settlement locations requiring minimum labor for maximum return and also to establish community authority under the person leading the fissioning group independent of that excercised by the community from which fissioning took place. Contraception appears to be a matter of choice revolving about maintaining a certain freedom from the cares of motherhood until such time as the marriage partners are reasonably convinced that the marriage is permanent. Indirectly, this contributes to the distribution of more effective female producers among the more effective male producers in the most productive areas, since a second marriage often involves shifting to a generally more effective husband whereas a shift to a less effective husband is scarcely to be found. Both fissioning and contraception, however, give evidence of techniques which were developed to handle man-food balance in happier days.

A number of formal characteristics of any ecology may permit us to deduce the form of society which would be expected on the basis of such characteristics. In so far as the ecological forms were to remain essentially unchanged over great periods of time, no changes in the forms of the social order attached to the ecological conditions would be expected. An internal equilibrium is maintained until such time as a dynamic imbalance occurs because of changes from internal or external sources. It is essential to examine to what extent the internal equilibrium prevents or fosters the occurence of dynamic imbalances in any particular ecological setting. We shall return to this question after the following itemization of Yaruro ecological forms.

[15A] [for footnote see p. 43, category 116 -- Analyst]

182 241 361 First, through time, the gardens tend to radiate further and further from any given residence point since, given the 13-year planting-fallow cycle, plots near the village will be exhausted. Since the major garden resource areas lie in a crudely east-to-west direction, there will be a slow westward migration of the geographic center of garden activities, enough so that at some point, the village is suspended, as it were, among distant resource points (see Maps), and enhanced by the dispersed nature of the hunting and fishing, and to some extent the gathering, areas. If the "suspension" is weighted more in one direction than another, there will be some tendency either to move the village or to send out temporary or permanent branches of it, respectively in the form of work cottages in the swiddens or in larger long-term house groups which are intermittently occupied. This process is, in fact, easily observed among the Yaruro in existent and abandoned house and subsidiary village sites scattered over the whole territory. Similarly, the locus of gathering, so important in [221] summer, moves further and further from the village. This, together with the considerable shift to fishing and river-hunting in summer, as well as the need for water, causes an extensive seasonal transhumance to occur within the territory. These factors contribute to fissioning as well as to inhibiting the development of permanently located villages, let alone larger aggregations. Thus, with a radiating ecology, a degree of group dispersion and geographical mobility within the territory is to be expected and is indeed characteristic of the Yaruro.

512 Second, if one examines the location of all resources it will be seen that, taken together, they constantly enjoin a dispersal of the labor force in all directions, regardless of season, so that more or less equivalent quantities of labor are being used at the same time in many varying kinds of productive activity independently of each other — at the peripheries of the territory, in the areas between, or in the village centers themselves, [462] where the women are constantly doing the significantly important work of [252] converting otherwise unusable food resources, like raw, bitter manioc or uncooked corn, into edibles.

476 Third, it will be noted that none of the Yaruro technological processes require cooperative work, even when they may permit it, if it were so desired. On the whole, the productive activities might be described as dispersive of labor, whether it is individuals or small groups of twos or threes who go out to keep each other company. Even the work of preparing [241] the swiddens is carried out individually, though two or three men may [463] work as neighbors in what appears as a single plot. Further, the technology [242] is such as to require no highly specific and difficult or esoteric skills. The most difficult skill to acquire is the knowledge of the soil types and appropriate planting procedures attached to each. Thus, each adult is in a position to learn the inventory of technological knowledge appropriate 462 to his or her sex, and somewhat of that belonging to the other sex too, and 463 to apply it by himself whenever he wants or must. A man, well-instructed in Yaruro technology, could probably subsist alone successfully for long periods of time. One divorced adult man, although he was largely fed by his

mother's and sister's households, nevertheless hunted and harvested for himself, and often cooked for himself meals of the type ordinarily cooked only by women. 462 463

The forms and characteristics of surpluses, as defined by Harris, [16] Ashed further light on the structure of the ecology. The technological surplus, defined as the difference between total calories annually produced by any definable group and the calories used to produce them, or as the ratio between these two figures, may be estimated at about 8 or 9 to 1 as compared with Harris's estimated figures of 2:1 for the Sirionó or 33:1 for the Pencuyut Maya. [17] Since as Harris remarks, the degree of social stratification in a large number of cases correlates with the size of the technological surplus, we would scarcely expect to find social stratification among the Yaruro, nor even any significant ranking. Where the technological surplus is low, the producer's surplus, defined as the difference between total calories produced by any given group and the total calories used by the producers for all purposes must also be low. Therefore the number of persons other than producers who can be supported by the producers is also limited. The producers' surplus may provide an index of the degrees of specialization which might be expected. In the case of the Yaruro one would expect no, or very low, specialization. Again, with a low producers' surplus, one would expect to find a greater proportion of the group involved in production than where such surpluses are high, for otherwise there would be insufficient calories to support more than a few people other than the producers. With a low producers' surplus, one would expect, in general, to find a greater proportion of both sexes engaged in the food quest. This is, of course, born out in the case of the Yaruro. Finally, Harris's harvest surplus is defined as the difference between the amount produced at any given moment, especially at seasonal maxima, and the amount consumed at that time. The actual amount consumable is governed by the seasonal *minima*, since the population cannot rise higher than the food supply at minimum periods permits unless special technological features such as storage, are present. Where the harvest surpluses are of non-storable goods, the population level is in equilibrium with the absolute minima of the harvests. The greater the degree of storability through a nonproductive season, or the less marked a crop is by seasonality, the higher the level to which the minimum population can be raised as compared with the number of people supportable at levels of production comparable to those at the time of harvest. Storability, however, is only one dimension of the harvest surplus. Absolute size of the peak surpluses, their regularity over the years, their distribution in space and time in the annual cycle, their utility in raw form, and the proportion of labor needed to harvest them relative to the time allotted for the harvest are all important dimensions of the harvest surplus. Thus, manioc, the Yauro's chief food resource has no clear peak, is regular over the years (the Yaruro disclaim any famines), is storable both in raw form and in prepared forms, is, in the case of the Yaruro, so located as not to permit of a concentration of labor at any one time and needs no massive labor for harvesting because of short harvest periods. Thus, in general, the very nature of manioc as a crop, and the labor requisites for

121 433 182 [56] [463] [462] [262] [251] [241]

A16, 17 [For footnotes see p. 43, category 116.--Analyst]

121 182 433 [241] [22] harvesting it, require no centralized authority and render it possible and even probable that the management of production or distribution be carried on without it. The same may be said, on the whole, for all the hunting, fishing, and gathering harvests, a notable and probably permanent feature of Yaruro ecology. Perhaps the only crop which has a marked seasonality is corn, but its absolute size in the total production, its geographical distribution in production, and its position relative to all other harvests renders it insignificant as an effective promoter of managerial functions and [56] formal arrangements of social stratification. It is unlikely, given Yaruro ecology that the forms of surplus would change; consequently their concomitants in social structure would remain constant.

On the basis of the formal characteristics of the ecology and of the surpluses one may deduce an essentially egalitarian social organization, with minimal ranking and leadership and with dispersion of the acts of [56] economic distribution among a number of adult males or females any one of [462] whom may produce a small harvest surplus at any time. With a relatively steady and reasonably comfortable total subsistence base, and with ecological arrangements which are spatially repeated in identical form up 182 and down river, no necessity exists for stringent rules of local exogamy [582] as an institution to regulate the labor force by redistributing its members. One would expect frequent marrying in the village according to the convenience of the contractants, and out-marriages to occur either as ecoomic opportunity offered elsewhere or lack of women at home urged one out. The [562] combined biological and productive role of women, with their particularly important technical roles in gathering and in food preparation, suggest sedentary communities and a matrifocal emphasis in the rules of residence. However, the importance and location of the men's economic contribution might be expected to balance this to a degree so that one might deduce [591] male uxorimatrilocal residence but with other, subsidiary patterns. This in fact occurs, occasional male matrilocality or patrilocality [18] comprising the subsidiary residence rules. Political authority would be vested [623] in the community, mainly among its elders, since little or no ranking or stratification is to be expected. In fact, Yaruro socio-political forms, in general, conform to all of these deduced conditions. They represent a model for any society based on the kinds of ecological conditions or form of ecology we have described. Where the ecology is even more restricted the deduced characteristics should be matched even more closely by the observed [171] data. In this respect, the Sirionó, for example, tend to confirm the hypothesis, in that their partial sedentariness which revolves about horticulture is associated with matrifocal social organization: matrilocality and matrilateral cross-cousin marriage. They also possess autonomous local communities. [19] The Apinayé also tend to confirm the hypothesis. [20]

Where our analysis permits us to predict about the course of the ecological conditions, we should also be able to extend this prediction to the social structure. Since, under the given ecology, we can establish a maximum population for each Yaruro socio-cultural unit, and under the given technology we would expect no significant change in the ecology, no significant

[18,19,20 [for footnotes see pp. 43-44 category 116 --Analyst]

change of form in Yaruro society would be expected. Changes could occur only by virtue of a changed technology derived either from internal developments or diffusion.

It is justified to assert, I believe, that, given the technological and ecological conditions of the Yaruro, internal developments of an evolutionary sort would be unlikely, or, at best, exceedingly slow. It seems to the writer, that the nature of the wet and dry savana soils at least in the Cinaruco area precludes any possibility of cropping by means of slash-and-burn horticulture, or even, to any extent, by modern agricultural means. Therefore development would have been restricted to improvements in the existing technology such as the domestication of new plants or the improvement of old ones grown in the restricted areas along the streams. Maximum surpluses would still have been restricted, and the singular ecological relations of this region would nevertheless have been maintained. Improved fishing techniques might have increased output - the weir, the trap, poisons (used by some groups of Yaruro), nets and seines, fish pools would have increased the fish intake, but there are no salmon runs or the like, here, so that a maximum would soon have been reached in fishing too.

Of introduced food plants and animals, the same may be said, unless some plant growing with notable success in the dry sandy savana soils had appeared. However, no such plant was available from any surrounding source and still is not. It is doubtful whether techniques of fertilization could either have been internally evolved or brought in from other peoples which would have made a significant difference to production. In fact, even with a modern agronomical technology, as well as better soils than possessed by either the Cinaruco or Capanaparo Yaruro, the problem of fertilization of their savana lands has not been solved even by contemporary Venezuelans. Had it been possible to develop any form of fertilizer under native conditions, the best that might have occurred would have been to raise the swidden productivity somewhat, thus raising the population. But it is doubtful if it would have significantly changed the forms of surplus, the ecology, or social structure. Conceivably, however, villages might have become larger and more fixed and ranking somewhat more marked.

Among the Yaruro, water control would have been impossible, because the small streams, and even the larger caños, dry up in summer altogether while the rivers are reduced to relative trickles. Any significant irrigation system would have had to have been on such a scale as only a major state could undertake a state of greater proportions and wealth than contemporary Venezuela for example. Even had such been possible, it is doubtfult whether irrigation would have helped the sandy savanas of the Cinaruco, so heavily leached by rain, though water control might well permit a large increase in agricultural productivity in the loamier parts of the llanos. Thus, a major agricultural technique known to relatively near neighbors of the Yaruro was for ecological and social reasons not diffusable.

Finally, warfare, which might have elicited a more hierarchical form of social organization, had not evolved as a Yaruro culture trait. In the

182 72 first place, the ecological conditions to the north, west, and south were, if anything, more severe than their own, so that there was little advantage to gain by warring in these areas. To the east were the Orinoco highlands, mountainous and heavily wooded country, an ecology quite different from, and probably as difficult as, their own.

182 We may conclude then, that, with the given technology, and under the given ecological conditions peculiar to the Yaruro region, the possibility of evolving to a more advanced tropical forest type like the Kuikuru, or even the Carajá, who in a number of ecological respects are like the Yaruro, was extremely limited. Second, there was little possibility of circumventing this development by directly taking on Circum-Caribbean traits from nearby groups. The Yaruro had to remain, under native systems of [177] subsistence, which did not include the European-derived cattle herding now found in the llanos, at a fixed level of technology, with a fixed ecology, and hence with a fixed form of social structure. Only the recent exposure to cattle herding is breaking up the fundamental form of their economy.

Under any conceivable native conditions, the basic ecological relationships and forms would have had to remain essentially unchanged. We may therefore deduce that the concomitant socio-cultural structure would have had to remain unchanged. Yaruro society was, for ecological reasons, substantially at an evolutionary dead end.

000 With this view of Yaruro ecology and cultural development, we may turn to the question of what conditions of incipient tropical forest horticulture might have provided a foundation for evolution to a higher level. The inhibition of Yaruro development is a result of certain specific ecological limitations. Consequently, where those limitations do not exist or could be removed, one would find, other factors being equal, conditions under which incipient horticultural groups would evolve to higher levels of organization.

Holding technology constant, a much greater per cent of tillable to total land, say up to 50% [21] instead of 0.5%, would allow for an enormous increase in population - up to a hypothetical 12,500-15,000 [22] - which would permit or rather demand, a more elaborate social organization. A marked seasonal fluctuation in the productivity of these lands, that is, in the production of surpluses, would provide a situation in which forms of stratification could appear. A proportionally greater dependence on these food resources requiring intensive labor in order to maximize yield per acre, as in the case of corn or yams, would provide the basis for more elaborate socio-political organization. Thus, manioc which produces the largest tubers in relatively *poorer*, weakly nitrogenous, soils, requires much less effort to produce the several millions of calories per acre mentioned above than do corn and yams in better soils in order to push their productivity up to the maximum half-million calories per acre. Corn and yams appear to produce more with intensive care such as hilling and weeding, as well as the use of birdwatchers, and the like, as the papers on both the Taino and the Sub-Andean which follow clearly indicate. Where manioc will not conveniently grow

[21, 22 [for footnotes see p. 44, category 116 -- Analyst]

but corn or yams, or ecologically similar crops, will, in a considerable number of cases, one would expect to find more evolved socio-cultural systems than among manioc planters. 000

Again, where technical procedures could be introduced by innovation or diffusion for use by the local group, one might expect to find development occurring. Thus terracing as a means of increasing productivity, hence surpluses and probably the forms of surplus, is a technique which is diffusable under certain conditions existing in the recipient culture. Thus some of the hill-societies without terracing, mentioned in Reichel-Dolmatoff's paper below, could doubtless eventually have taken it on. Similarly, irrigation could conceivably have been introduced in certain low-land areas where water-flow and soil conditions were appropriate. In such conditions a long-term evolutionary development might occur.

Finally, where groups had maximized production in their own areas and had well-off neighbors, or, on the other hand, had considerably differing resource areas from their neighbors, warfare as a social technique, might have contributed to the development of internal differentiation and eventually to the territorial and organizational expansion of the cultures concerned. This was plainly the case on the Andean coast, and seems prettly clearly to have been what was happening in parts of the Circum-Caribbean and Sub-Andean areas, as the following papers show.

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TABLE I

Number, Size, and Crop Areas of Gardens of the Totudoro Yaruro: % [1] of Garden Planted to Each Crop and Areas in Acres.

Gardens #	Sq. Ft.	Acres		Manioc % Acres	Corn % Acres	Bananas % Acres	Cane % Acres	Squashes % Acres	Inyame % Acres	Other[2]
OLD: Totally abandoned (4th and 5th years)										
3.	15,000	0.35								
36.	10,000	0.23								
37.	15,000	0.35								
38.	8,000	0.19								
39.	8,000	0.18								
40.	12,000	0.28								
43.	10,000	0.23								
44.	10,000	0.23								
Total	88,000	2.04	2.04							
OLD: 3d and 4th years										
6.	13,500	0.31				sparse[3]				
8.	5,000	0.12				sparse				
11.	8,500	0.20				negligible				
12.	13,000	0.30				sparse				
16.	32,500	0.74				little				
20.	6,500	0.15		sparse						
41.	15,000	0.35				negligible				
42.	15,000	0.35				negligible				
Total	109,000	2.52	4.56							

TABLE I (cont.)

Gardens #	Sq. Ft.	Acres		Manioc %	Manioc Acres	Corn %	Corn Acres	Bananas %	Bananas Acres	Cane %	Cane Acres	Squashes %	Squashes Acres	Inyame %	Inyame Acres	Other[2]
MATURE: 2nd & 3rd years																
1.	60,000	1.40		100	1.40	—	—	—	—	—	—	—	—	—	—	—
4.	3,000	0.07		90	0.06	—	—	—	—	—	—	—	—	10	0.02	—
5.	7,000	0.18		80	0.14	—	—	20	0.04	—	—	—	—	—	—	—
7.	6,000	0.14		—	—	—	—	20	0.03[4]	80	0.11	—	—	—	—	—
9.	50,000	1.16		60	0.70	—	—	10	0.12	25	0.29	—	—	5	0.06	+[5]
10.	1,000	0.02		—	—	—	—	—	—	sparse		—	—	—	—	—
13.	25,000	0.58		40	0.23	—	—	25	0.15	35	0.20	—	—	—	—	—
15.	16,000	0.37		—	—	—	—	30	0.11	70	0.26	—	—	—	—	—
23.	20,000	0.47		25	0.12	—	—	30	0.14	45	0.21	—	—	—	—	—
26.	10,000	0.23		—	—	—	—	20	0.05	80	0.18	—	—	—	—	—
28.	40,000	0.92		50	0.47	—	—	10	0.09	40	0.37	—	—	—	—	—
31.	30,000	0.70		100	0.70	—	—	—	—	—	—	—	—	—	—	—
34.	13,000	0.30		100	0.30	—	—	—	—	—	—	—	—	—	—	—
35a.	10.000	0.22		55	0.13	—	—	30	0.07	10	0.02	5	0.01	—	—	+[6]
Total	291,000	6.76	11.32		4.25				0.80		1.64		0.01		0.08	Acres
NEW: First year																
14.	14,000	0.32		—	—	—	—	—	—	100	0.32	—	—	—	—	—
17.	6,000	0.14		35	0.05	—	—	20	0.03	35	0.05	—	—	10	0.01	—
18.	6,000	0.14		45	0.06	45	0.06	—	—	—	—	—	—	10	0.02	—
19.	6,500	0.15		35	0.05	35	0.05	10	0.02	12	0.03	—	—	5	0.01	—
22.	8,000	0.18		—	—	—	—	35	0.06	65	0.12	—	—	—	—	—
24.	37,500	0.86		45	0.39	—	—	35	0.30	20	0.17	—	—	—	—	—

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TABLE I (cont.)

Gardens #	Sq. Ft.	Acres		Manioc %	Manioc Acres	Corn %	Corn Acres	Bananas %	Bananas Acres	Cane %	Cane Acres	Squashes %	Squashes Acres	Inyame %	Inyame Acres	Other
25.	9,500	0.22		35	0.08	35	0.08	20	0.04	10	0.02	—	—	—	—	—
27.	1,950	0.05		—	—	—	—	—	—	—	—	200[7]	0.10	—	—	—
29.	2,500	0.06		100	0.06	100[8]	0.06	—	—	—	—	—	—	—	—	—
30.	15,000	0.35		80	0.28	80[9]	0.28	20	0.07	—	—	—	—	—	—	—
32.	13,000	0.30		—	—	—	—	—	—	100	0.30	—	—	—	—	—
33.	13,000	0.30		55	0.17	55[10]	0.17	20	0.03	20	0.06	—	—	10[11]	0.03	—
35b.	10,000	0.22		50	0.12	60[12]	0.14	30	0.07	10	0.02	10	0.02	—	—	+[13]
Total	142,950	3.29	14.61		1.26		0.84		0.65		1.09		0.12		0.07	Acres
IN PREPARATION																
2.	15,000	0.35		—	—	—	—	—	—	—	—	—	—	—	—	—
21.	20,000	0.46		—	—	—	—	—	—	—	—	—	—	—	—	—
Total	35,000	0.81	15.42													

1. These percents are highly approximate since crops were often distributed quite irregularly around gardens, often even interplanted. They represent impressionistic guesses.
2. These mostly include yautía ('ocumo'), pineapples.
3. 'Sparse' means that trees are scattered here and there, bearing lightly; 'negligible' refers to a few atrophied bunches in an entire patch; 'little' means a very small production, above sparse.
4. These were very sparse.
5. Pineapples, yautía.
6. Pineapples, pumpkins, yautía.
7. Successively planted to melons and squash in same season.
8. Double cropped in same area.
9. Corn and manioc double cropped in same area.
10. Corn and manioc double cropped in same area.
11. Inyame interplanted among corn and manioc.
12. Double cropped with manioc.
13. Yautía, pineapples, melons, pumpkins.

2:Leeds E-5 (1958)1961 SS19 Yaruro SS19

TABLE II

FOODS: THEIR GEOGRAPHICAL PROVENIENCES, TECHNIQUES AND SEASONS OF PRODUCTION; THE DIVISION OF LABOR IN PRODUCTION AND FOOD PREPARATION

Symbols: S.F W.S — summer, fall, winter, spring
M.F. — male, female
Q — evaluation of the quantitative importance of the food or raw material in Yaruro subsistence and productive activity: 5 — major staple or resource; 4 — major crop, but not a staple; 3 — important food (or other) resource, but a secondary crop; 2 — minor crop (or other resource) serving as a more or less regular but seasonal delicacy; 1 — mostly a delicacy for occasional enjoyment (very secondary resource)
ψ — indicates both presence, and by doubling or tripling importance of crop or resource; three ψψψ's do not necessarily mean "3 times as important as 1 ψ", merely "of outstanding importance".
/ — sporadically or slightly present
d-m — December to March; a — April; m-s — May-September; o-n — October to November.

Yaruro	Spanish	English	Location and Techniques	Season of Prod. S (d-m)	F (a)	W (m-s)	S (o-n)	Division of Labor Prod. M	Prod. F	Food Prep. M	Food Prep. F	Q
CROPS PLANTED:												
ṯoe-ka'ra (1)	yuca amarga	bitter manioc	swiddens, cuttings, dibble	ψψψψ	ψψψψ	ψψψψ	ψψψψ	ψψψψ	ψ	/	ψ...	5
1. p. ṯo-ka'ra	cachicamo	" (variety?)	as above									
2. p. a'punda"ki be'ribeti"a	cuibita (?) (blanca)	" (light)	as above									
3. p. a'punḍ"ki-k'a'Ra	cuibita (?) (obscura)	" (dark)	as above									
'hurari"à-'poe	yuca dulce	sweet manioc	as above									
1. p. ngui'kwe	yuma de huevo	" (variety?)	as above	ψψ	ψψ	ψψ	ψψ	ψψ	ψ		ψψ	4
2. p. ici'kwe	pata de zamuro	" (variety?)	as above									
3. p. valenciana	valenciana	" (", introd)	as above									

(1) Phonetics: *ą* etc. = nasalized vowel, *ə* = mid central unrounded vowel, *ch* = palatal c., *y* = palatalized fricative; *R* = flapped *r*, *nj* = palatalized nasal continuant, as in English sing, *j* = palatalized affricate, as in English jab.

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Yaruro	Spanish	English	Location and Techniques	Season of Prod. S d-m	F a	W m-s	S e-n	M	Division of Labor Prod. F	Food M	Prep. F	Q
$pw_ɛ$	maiz	corn, maize	swiddens, hills, dibble			≠≠≠	≠≠≠	≠≠≠	≠	≠	≠≠≠	4
1. pume'$pw_ɛ$	maiz yaruro	Yaruro corn	as above (3 mo., 1 ear/stalk)									
2. 'hamburu"a$pw_ɛ$	maiz guahibo	Guahibo corn	as above (4 mo., 2 ears/ ")									
3. p. $kw_ɛ$"$kw_ɛ$ia	maiz amarillo	yellow corn	as above (5 mo., 1 ear/stalk)									
'parau"ai	plátano, topocho, banana	plantains, bananas	swiddens, machetes to cut, on specially prepared mounds, slips	≠?	≠?	≠≠≠	≠≠≠	≠≠	/		≠≠	4
1. p. 'ai	plátano	plantain	as above (raw or cooked)								≠	
2. p. wu'ko	topocho	plantain	as above (raw or cooked)								≠	
3. p. o'kwi	dos millos	banana	as above (raw or cooked)								≠	
4. p. ka'ru	?	plantain	as above (?)								?	
5. ocrchu'$m_ɛ$ p.	guineo (?)	plantain	as above (raw or cooked)								≠	
6. ka'mure	cambur	banana	as above (raw)									
hu'ra	fiame	yams	dry swiddens, dibble	≠?	≠?	≠	≠≠	≠			≠≠	2
e'de	patilla	melons, pumpkins, squashes	swiddens dibble	≠≠	≠?	≠	≠≠	≠≠	/		≠≠	2
1. $kw_ɛ$"bohurariše.le	"	water-melon	as above									
2. chumanile.	"	pumpkins	as above									
3. 'yako"da	"?	bottle gourd	as above									
chuni'i	caña	sugar cane	wet swiddens, dibble, machete	≠?	≠?	≠≠≠	≠≠≠	≠≠≠	≠	/		3
1. ch. mo'ra	caña ?	" (variety ?)	as above									
2. ch. $b_ɛ$'re$b_ɛ$re"a	caña blanca	white cane	as above									
	caña criolla	introd var.	as above									

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Yaruro	Spanish	English	Location and Techniques	Season of Prod. S d-m	F a	W m-s	S o-n	Division of Labor Prod. M	Prod. F	Food M	Prep. F	Q
'cɛtame"kwɛ	fame	yams	swiddens, dibble	×?	×?	×	×	××	/		××	2
ña"ri	batata	sweet potato	as above	×?		×?	×	××	/		××	2
ô	ananá	pineapple	swiddens, dibble				×	×			/	1
iu	capacho	?	swiddens, ?				×?	×			1	?
cɛ'da(=cɛda"dakwɛ	ocumo (yauta)	xanthosoma	swiddens, dibble	×?		×	×	×			×	2
(ñô'tɛa"nâ	ají	chili pepper	doubtful if raised on Cinaruco)									
FISHES CAUGHT:												
yagu'pe	agua dulce	?	rivers, caños, hooks, arrows	×				×		/	×	3-
e(='chamachi"ro)	cachama	?	rivers, hooks, arrows	×				×		/	×	1
gui"ɾe	sardina	?	rivers, fish arrows, small hook	×	×	×	×	×		/	×	2
dap'we	guavina	?	caño fishhooks	×			×	×		/	×	?
ho'nó	palambre	?	rivers, caños, arrows, hooks	×?		×	×	×		/	×	2
ip:'â	pinte tigre	?	rivers, caños, hooks	×	×	×	×	×		/	×	3-
pa'chowén"ti	bagre	catfish	rivers, caños, hooks	×	×	×	×	×		/	×	3-
'meô"dakwɛ	viejita	?	as above	×	×	×	×	×		/	×	?
'chûinda-"yii	"	?	as above	×	×	×	×	×		/	×	?
ainda'ô	"	?	caños, hooks, sardine bait	×	×	×	×	×		/	×	?
uji'ri-ka"Rà	" negra	?	caños, hooks	×	×	×	×	×		/	×	?
u'ru-u'ru	de tierra	?	rivers, hooks	×	×	×	×	×		/	×	?
da're	pavón	?	rivers, hooks, sardine bait	×	×	×	×	×		/	×	?

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Yaruro	Spanish	English	Location and Techniques	Season of Prod. S d-m	F s	W m-s	S o-n	Division of Labor Prod. M	Prod. F	Food M	Prep. F	Q
chu'me	"	?	rivers, caños, hooks, sardine bait, from platform	—				—		/	—	?
'yaka'ra	"	?	as above, also arrows	—	—	—	—	—		/	—	2
'Yoçok'e"ne	" colorado	?	rivers, caños, hooks	—	—	—	—	—		/	—	?
áš	caribe blanco	white piranha	rivers, arrows, hooks with especially heavy cord	—				—		/	—	1
(hòde'cia	caribe	piranha	doubtful if caught on Cinaruco)									
(pu'pu	cajarro	catfish	doubtful if caught on Cinaruco)									
FRUITS, ROOTS, AND SEEDS GATHERED:												
ro'cho	?	?	in mata from big tree, at foot	—				—				1?
ga're (cho'nó)	guayaba	guava	bushes and low trees, distant			—		—				1
t'u	fruta de moriche	miriti palm fruit	near caños in wet savana, from foot of trees			—	—	—			—	2
'nunn"be	?	?	?, from big tree (monte?)			—		—			1	?
nn'be	?	?	?, ?			—						1
nn,n'ni	cordón	tassel (?)	?, from tall trees (prob monte)			—		—				1?
nkai'cho	cacaito	?	?, ?			—						1?
nuri"to	?	?	?, ?			—						1?
ya'kol,	totumo	calabash	monte (?), picked				—	— ?			— ?	2
ni'pi	changuango	?	wet savanas, digging stick	—					— —		—	2
cho'kai	guapo	?	monte, savana, digging stick	—	—	—	—		— —		—	2

Yaruro	Spanish	English	Location and Techniques	Season of Prod. S d-m	F a	W m-a	S a-n	Division of Labor Prod. M	Prod. F	Food M	Prep. F	Q
ma'hikxi	solu ??	?	savana, digging stick	½					½		½	1
ka'ta	changuanito savanero	?	as above	½½					½½		½	21
pa'ta	barbaco	?	monte, digging stick	½½					½½		½	3
gwa'pe (=gwepe'ka)	chigo	? (seed)	near monte, big trees, ground			½½			½½		½	2
gu (=ka)	chigo	? (seed)	?, ? (as above?)								½	?
ANIMAL HUSBANDRY:												
o'bwela	marrano	pigs	savanas, herding (introd.)	2½	½½	½½	½½	½½	/	½½	½½	3
oka'zaro	gallina	chickens	dunes near houses (")	½	½	½	½	½	/		½	1
ANIMALS HUNTED:												
(ta)ha'riga'ri(a'ni)	oso hormiguero	giant ant eater?	savana, bow and arrow	½	½	½	½	½		½	½	4
ha'ri	baba	alligator	rivers, heavy barbed arrow	½½	½½		½	½½		½½	½	3
mbwa	venado	deer	savanas, lance arrow, gun	½	½	½	½	½½		½½	½½	3
ci'do	chigüire	capybara	monte, river, " ", fish arrow	½½	½	½	½	½½		½	½	4
tapa'ta	conejo	rabbit	savana, fish arrow	½	½	½	½	½		?	½	1?
puri	lapa	paca	caño, monte, traps, all arrows	½	½	½	½	½		?	?	1?
ya'tatu"mi	iguana	water lizard	rivers, montes, fish arrow	½	½	½	½	½		?	?	1?
'ga"ra	cachicamo	armadillo	savanas, traps, sticks, hand	½	½	½	½	½		½	/	4
'ipurime"ta	manta	?	savanas, traps, arrows	½	½	½	½	½		?	?	?

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Yaruro	Spanish	English	Location and Techniques	Season of Prod. S d-m	F a	W m-s	S e-n	Division of Labor Prod. M	Prod. F	Food M	Prep. F	Q
'yaɛn"te	picure	? (aguti?)	monte, caño, fish arrow	≠	≠	≠	≠	≠		?	?	?
'iku"ri	tortuga	tortoise	rivers, fishhooks; on Capanaparo, use detachable arrow	≠≠			≠	≠		?	?	2
poda'me	terecal	terrapin?	rivers, fishhooks " "	≠≠			≠	≠		?	?	2
geda'me	morrocoy	boxturtle	mata, by hand - doesn't run	≠	≠	≠	≠	≠		?	?	1
ci'rida"me	galápago	river turtle	rivers, detachable arrow	≠≠			≠	≠≠		?	?	2
('hôi-obwei"a	chácharo	peccary	doubtful if hunted on Cinaruco)									
(be'ri	manatí	manatee	doubtful if hunted on Cinaruco)									
BIRDS HUNTED:												
he'we	cotua negro	duck species	rivers, caño, arrows	≠				≠		?	≠	1
hà'na	carretero	?	rivers, lakes, arrows	≠				≠		?	≠	1
andu'ra	garza morena	grey heron	rivers, lakes, arrows	≠				≠		?	≠	1
o'kara	garza blanca	white heron	lakes, arrows	≠				≠		?	≠	1
'huidiga'ra	garza paleta	painted heron?	lakes, arrows	≠				≠		?	≠	1
hue	gaviota (?)	?	lakes, arrows, bird arrow	≠				≠		?	≠	1
'kwiachi"ni	perdiz	partridge?	savana, bird arrow (?)	≠				≠		?	≠	1
hu'ru-yu'ru	pavo	curassow	rivers, monte, arrows	≠	≠	≠	≠	≠		≠	?	2
ta'ra	jivaro (?)	jivaro stork?	lakes, arrows, shotgun	≠				≠		≠	?	2?
noraha'te	pato real	duck species	lakes, arrows	≠≠				≠		?	?	?

Yaruro	Spanish	English	Location and Techniques	Season of Prod. S d-m	F a	W m-s	S o-n	Division of Labor Prod. M	Prod. F	Food M	Prep. F	Q
pe'be	cutua	duck species	rivers, caños, arrows	✓✓	✓	✓	✓	✓✓		?	?	2?
pou'nà	pato	duck species	doubtful if hunted on Cinaruco)									
MISCELLANEOUS MATERIALS COLLECTED FOR USE IN PRODUCTION:												
ya'ro	capuruna	leaf to wrap and store corn sticks	savana, picking			✓ ?			✓		✓	1
karam'ba	?	cigar wrapping	savana, picking	✓	✓	✓	✓	✓ ?		✓	✓	1
agam'bi	tabaco	tobacco	savana, picking	✓	✓	✓	✓	✓	✓	✓	✓	1
u'de	curagua, macanilla	macanilla palm	near caños (?) a) for bows, b) for string, fibres for objects	✓ ✓	✓ ✓	✓ ✓	✓ ✓	✓ ✓ ✓		✓ ✓ ✓	✓ ✓	3 3
chara't'o	salau (salado?)	canoe wood (?)	montes, for making canoes	✓	✓	✓	✓	✓ ✓		✓ ✓		4
cio'ı't'o	caña brava	cane for arrows	near caños for foreshafts	✓	✓	✓	✓	✓ ✓		✓ ✓		4
ru	moriche	moriche	near or in caños, used for making house roofs, baskets, cords, fibres, hammocks	✓ ✓	✓ ✓	✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	5
ago	moriche frond	ditto	as above, often picked up from ground, or tree cut and fronds collected, last for years, may be reused.		as above							
biri't'o-i	guasca	bark strips	montes, caños, for lashing	✓	✓	✓	✓	✓ ✓		✓ ✓		3
é-im'bu	cera de abeja	beeswax	near caños, from large trees	✓	✓			✓		✓		1
é-'ke	miel	honey	as above	✓	✓			✓				-
e'ra	peramán	tree wax	as above? for arrows	✓?	✓?			✓		✓		2

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Yaruro	Spanish	English	Location and Techniques	Food M	Food F	Prep F
COOKED DISHES AND THE DIVISION OF LABOR — CONVERSION OF FOODSTUFFS IN VILLAGE						
cham'pe	arepa	corn cakes	kernels crushed after shelling, fried in deep fat or boiled; grater often used		/	ɟɟɟ
ui'ta	?	corn purée	crushed corn (after frying raw kernels in deep fat, or simply boiling) mixed with water; grater may be used for mashing		/	ɟɟɟ
pwɛ-u'ni	?	corn powder	dry hard kernels grated on metal grater (men make holes with nails) and then eaten dry		/	ɟɟɟ
iu	?	corn on cob?	boiled			ɟ
po'nô	?	corn kernels	dry, relatively hard kernels are shelled from cob, then roasted in deep fat, salted, and eaten		ɟ	ɟɟ
ca'dɛ	capuruna	corn sticks	shelled kernels grated into mush, carefully wrapped in capuruna leaves, boiled; stored or eaten directly		/	ɟɟɟ
'pwɛ-e"ro	guarapo de maiz	corn juice	kernels are mashed to express juice, thick liquid		ɟ	ɟɟ
tambɛ	cazabe	bitter manioc	manioc flower prepared by cutting, grating, squeezing in tipiti, etc.			ɟɟɟ
1. tam'bɛ	cazabe	manioc cakes	flour prepared in flat cakes and roasted			ɟɟɟ
2. tam'bɛ-e'ro	guarapo de cazabe	boiled m. juice	juice is boiled to break down prussic acid		/	ɟɟ
3. tam'bɛ ?	carato	fermented "	flour and juice added to corn juice, ferments ca. 12 hr.		ɟɟ	ɟ
'oka"raru-"né	huevos	chicken eggs	usually fried			ɟ
'hurari"â-'pae	yuca dulce	sweet manioc				
1. ?	?	fried slices	fried in relatively shallow fat		/	ɟɟ
2. ?	?	deep fried	fried in deep fat			ɟɟ
3. ?	?	boiled	boiled whole after peeling (as above)			ɟɟ

Yaruro	Spanish	English	Location and Techniques	Food M	Prep P
'pazaraɨ	plátanos, topochos, bananas	plantains and bananas	many types often eaten raw; below are considered only those which are cooked		
1. ?	?	boiled	peeled and put in water to boil till soft	/	✓
2. ?	?	fried slices	peeled, sliced, put in deep fat till hard		✓✓
o'bweɨa	marrano	pork	most of the work of killing and preparing is done, as with most meats, by the men; only boiling is usually done by women who own pots		
1. ?	?	boiled	small chunks boiled till almost mushy	/	✓✓
2. ?	?	roasted	put on sticks over fire, facing it	✓✓	
3. ?	chicharrones	cracklings	hide with thick layer of fat fried in its own fat till fat (and hide) are hard; stored for some time	✓✓	
4. ?	?	deep fried	meat parts are deep fried till almost crisp		✓✓
5. agwei kɨ"pàkɨ"to	?	blood sausages	blood carefully caught on slaughtering and saved in vessell till coagulated then stuffed into unwashed (?) intestines and cooked	✓✓✓	
chwɨ"ɨ-e'ro	guarapo de caña	cane juice	squeezed out on "chaqui-chaqui", a wooden hand press	✓	/

NB—Preparation of foods produced only in the dry summer months, such as chanchango root and chanchanito savanero root were not observed and are not included here. These roots are both boiled by the women. Most meats, unless boiled, are prepared by the men by roasting. Fish, in general are prepared by women. Most fruits and seeds which are not eaten directly upon collecting are cooked by women.

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MAP I- Winter Resource Areas

KEY

- SAND DUNES
- THICK MONTE SUITABLE FOR SWIDDENS
- SCRUBBY MONTE NOT FOR SWIDDENS
- GALLERY FORESTS
- GALLERY FORESTS FLOODED, NONARABLE
- THE PRESENT VILLAGE
- OLD OR ABANDONED VILLAGE SITES (WINTER HOMES)
- Pigs
- Manioc
- Water for drinking and cooking

Numbers represent gardens appearing in Table I

1 inch = ca 1.25 mi

Maps by Jo Leeds.

MAP II Summer Resource Areas

162
311
131
361
22

NOTES

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1. Ramia, 1959, charts p. 19 and 21. Ramia's data were also useful in confirming the writer's observations summarized in the description of topography and plant life. Cf. also Fiasson, 1947.

2. Soil tests on samples submitted by the writer made by Hugh Popenoe of the University of Florida College of Agriculture. See Footnote 9.

3. The description here given bears great resemblance to descriptions given by Carneiro, 1959; Conklin, 1957, pp. 49-71; Meggers, 1957, p. 80; Pelzer, 1945, Ch. II and photographs; as well as the writer's own observations in Brazil (Leeds, 1957, Ch. III).

4. Meggers, 1957, p. 80, citing Richards, 1952.

5. Lowie, 1940, p. 426, speaking of canella horticulture points out that the dibble is "unfit to cope with the arid regions of their country". Cf. also Carneiro, 1957.

6. Conklin, 1954, p. 141, and 1957, p. 138, states that the range, at least among the Hanunóo of the Philippines, is from 8 to 25 years. Pelzer, 1945, gives a figure of 8 - 15 years (p. 16).

7. Cf. Woodbury, 1954, Ch. 17. A similar point is made by Dorsey, 1884, by Braidwood, 1958, p. 25, and by Birdsell, 1958, p. 53, who speaks of aboriginal Australian populations as being "in equilibrium with the resources of the local environment".

8. Harris, 1959, p. 193.

9. Popenoe, 1959. He gives the following data based on four samples from the central Cinaruco area. The samples were not collected by standard techniques, so are subject to considerable error, nevertheless the results are sufficiently suggestive to be of interest:

Description of Sample	Texture	Organic Matter	pH	CaO lbs/A	MgO lbs/A	P_2O_5 lbs/A	K_2O lbs/A	N_2
1. Sand dune	fine sand	low	4.9	73	10	3	38	low
2. *Monte* swidden, 2nd - 3rd year	light fine sandy loam	low	4.2	36	31	0	47	low
3. Abandoned swidden, 5th year	mucky loam, fine sand	high	3.9	36	41	1	152	high
4. Banana mound active swidden	silt loam	high	5.3	1231	576	13	307	high
Florida minimum			higher	400	100-150	10	100-120	

Dr. Popenoe comments "For Florida soils, which are usually fairly sandy, we consider limiting amounts of the various nutrients to be about [as given above]... All of the pH values would be considered too low for good crop production in Florida but crops under tropical condition appear to tolerate lower pH values than in temperate climates." It should be noted that though these figures suggest soil deterioration through cultivation, this is not a universal concomitant of slash-and-burn horticulture. There is evidence (cf. Cassidy and Pahaiad, 1953) that soil conditions for certain crops may remain constant or even improve. No noticeable soil deterioration occurred in the slash-and-burn arboriculture of the

State of Bahia, Brazil, cacao-growers (Leeds, 1957, Ch. III). Conklin's material 000
suggests the same thing (1954, 1957).

10. See footnote 6.

11. The actual acreages presently in use are given in Table I. Of 200 acres only 1/10 (cf numerator of Figure 1) could be in cultivation at any one time, or 46 A., which would support about 92 people. Only about a quarter of that number, 24, actually use the area now. Correspondingly, one would expect only about a quarter of the available area for any one year to be cropped or about 11.5 acres. The actual figures on the Table add up to 10.09 or 12.57 acres (if one includes the 3d and 4th year, old plots). The average of these two figures is 11.3 acres, which is also only an approximation, but the fit is close.

12. Carneiro, 1956.

13. Carneiro, 1957, pp. 165-168; Barrau, 1956, p. 31, p. 32; Fauteux, 1952, p. 3. Carneiro gives .7 including pessary depredations which are very heavy in Kuikuru gardens; Fauteux gives .2; Barrau reports .5-.3 and up. Willey, 1953, speaking of the Coastal Andean type of horticulture, estimates 1 acre.

14. If, instead of the estimated .5 acre/person/year for his plant food, we use Willey's 1 acre or Fauteux's .2 acre, the range lies between 46 and 231.

15. Steward and Faron, 1959, p. 33-34.

16. This discussion is based on the important works by Harris (1958, 1959). The writer has somewhat extended Harri's concept of the harvest surplus by suggesting the various dimensions discussed in the text, although some of these are implicit in the 1959 article.

17. Harris, 1958. The same figures that Harris used in calculating the technological surpluses for the cited groups have been used here: an average of about 150 calories for average labor per person per hour, times the number of hours of food-producing labor, times the number of workers, times 365. I have included in the very rough estimates the time to walk to and from the gardens as being a necessary part of the food-production routine. I have not included an average of about 80 C/hour/person for basal metabolism on the basis that the basal metabolism must be accounted for whether the person is working or not — only the calories above basal are actually to be accounted to the production process. The estimates, though rough, are useful for comparative purposes.

As a preliminary estimate, I figure that the 9 men of the village average about 4 hours a day at food-producing work, though I suspect this figure is high. I allowed about 2.5 hours a day for the women, undoubtedly also high as a year-round average. I used an average calorie consumption for work of about 150 (cf McLester, 1927, Ch II and III) per hour per person working on food production. Performing the calculation we find the daily calorie output for all food production is about 2600 C. This times 365 days gives 8+ million C. If we estimate average total caloric consumption per day per capita at 2750 (possibly even a low estimate considering the Yaruro corn-manioc-potato-yam-sugar cane-pork diet) and multiply by 365 we get total calorie consumption as 34.06 million calories. If we make the further assumption that this latter figure, in the long run, is about equal to the calories produced, we find that the ratio of technological efficiency is minimally 8 to 1. Since our calorie use rates are probably high, and our measure of total calorie production per year probably low, the ratio might be as high as 9 or 10 to 1. If one adds in the 80 calories (probably high) per hour per person of the basal metabolism, the total calories used in production of calories amounts to 5 million, and the ratio of technological efficiency becomes 4.8:1, still about 3 times as great as the Hiraoá. The producers use about 13.65 million C. leaving about 5.5 million C. for non-producers as a producers surplus, or 29%.

18. I follow the usage of Fischer, 1958, here.

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19. Cf. Holmberg, 1950; Murdock, 1957. Holmberg suggests, incidentally, (p. 9) that the Sirionó were pushed into their present area, and were deculturated by this event. This implies that they were at a higher level of organization, which is also suggested by their linguistic affiliations with more advanced Tupian groups. These data suggest that the Sirionó should always have been classified, like the Yaruro, as Tropical Forest Horticulturalists rather than as Marginals (Steward, 1946-1950, Vol. III, pp. 897-899). Cf, on this latter point, Hohenthal, 1951.

20. Nimuendajú, 1939; Murdock, 1957.

21. Conklin, verbal communication, estimates that about 50% of the land surface possessed by the Hanunóo was capable of being cultivated.

22. This figure refers to a unit of land of the same size we have been discussing for the Yaruro — 65 square miles. 50% tillable land is a factor of 100 times the Yaruros' present tillable land. We estimated 125-150 people for this area, which, multiplied by 100 produces the figures given in the text.

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